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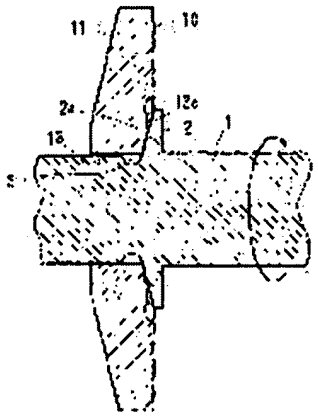
(54) PULLEY FOR CONTINUOUSLY VARIABLE TRANSMISSION

(57)Abstract:
PROBLEM TO BE SOLVED: To provide a manufacturing method of a pulley for a continuously variable transmission fully filling soft metal on a peripheral groove part provided to a shaft and having high connection strength between a flange part and a pulley part.
SOLUTION: The flange part 2 is integrally provided to the steel shaft 1, and a second faying surface 12a on the back side opposing to a belt contact surface 11 of the light-alloy pulley part 10 is fayed on a first faying surface 2a of the flange part 2 by friction pressure. The second faying surface has a larger softening margin of inner peripheral side than a softening margin of outer peripheral side, and part of soft alloy softened by friction pressure is filled into the peripheral groove part 3 of the shaft 1.



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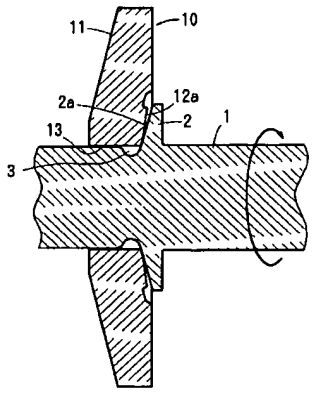
(54)【発明の名称】無段変速機用プーリ

(57)【要約】
【課題】シャフトに設けられる周溝部に十分な軟化金属を充填でき、フランジ部とプーリ部との結合強度が高い無段変速機用プーリの製造方法を提供する。
【解決手段】鋼製のシャフト１にフランジ部２を一体に設け、このフランジ部２の第１接合面２αに軽合金製のプーリ部１０のベルト接触面１１と対向する背面側の第２接合面１２αを摩擦圧接により接合する。第２接合面は、内周側の軟化代を外周側の軟化代に比べて大きくしてあり、摩擦圧接により軟化した軽合金の一部がシャフト１の周溝部３に充填される。
【選択図】　図２



【特許請求の範囲】
【請求項１】
鋼製のシャフトと軽合金製のプーリ部とからなる無段変速機用プーリの製造方法において、
上記プーリ部と接合される第１接合面を有するフランジ部を一体に設けるとともに、上記フランジ部の第１接合面に隣接するシャフトの外周面に周溝部を形成したシャフトを準備する工程と、
ベルト接触面と対向する背面に、内周側の軟化代を外周側の軟化代に比べて大きくした第２接合面を形成したプーリ部を準備する工程と、
上記フランジ部の第１接合面とプーリ部の第２接合面とを相対回転させながら摩擦圧接により接合するとともに、軟化した金属の一部を上記周溝部に充填する工程と、を有する無段変速機用プーリの製造方法。
【請求項２】
上記フランジ部の第１接合面には、プーリ部のベルト接触面と同方向に傾斜したテーパ面が形成され、
上記プーリ部の接合前の第２接合面には、上記第１接合面より頂角の大きなテーパ面が形成されていることを特徴とする請求項１に記載の無段変速機用プーリの製造方法。
【発明の詳細な説明】
【０００１】
【発明の属する技術分野】
本発明は無段変速機用プーリの製造方法、特に鋼製のシャフトと軽合金製のプーリ部とからなる複合構造のプーリの製造方法に関するものである。
【０００２】
【従来の技術】
【特許文献１】特開昭６３－１０４７９０号公報
従来より、Ｖベルトを用いて自動変速を行なう種々の無段変速機が実用化されているが、特に軽量化や放熱性の改善のために、プーリ部をアルミ合金などの軽合金で構成することが行われている。その場合、動力伝達軸（シャフト）は伝達トルクに対する耐久性を確保するため、鋼材を用いるのが望ましい。よって、ベルトと摩擦するプーリ部のみが軽合金化の対象となる。
【０００３】
このとき、鋼製のシャフトとアルミ合金製のプーリ部とを高強度に接合する必要があるが、従来の鋼とアルミ合金の高強度接合技術としては、「鋳込み」、「圧入」、「ねじの締付を利用した締結」などが考えられる。しかし、いずれの方法も、品質管理工程が多くかかったり、機械加工の必要な部分が多くなるなどの理由から、コスト高となっていた。
【０００４】
そこで、特許文献１に記載のように、アルミ製のプーリ部と鋼製のシャフトとを摩擦接合によって接合させる方法が提案されている。この方法は、アルミ製のプーリ部の内径を鋼製のシャフトの外径よりも小さくし、プーリ部を固定しシャフトを回転させて接合面を接触させ圧力を加えて挿入後、シャフトの回転を停止し、さらに加圧して接合するものである。
【０００５】
上記接合方法の場合には、プーリ部の内周面とシャフトの外周面とが接合面となるため、プーリ部にかかる推力（軸方向荷重）が接合面に対して　断方向に作用する。そのため、接合強度を上げるためにはプーリ部とシャフトとの接合幅を大きく取らなければならず、プーリ部の内径部の肉厚が大きくなり、重量が大きくなるという欠点がある。
また、プーリ部とシャフトとの接合面積が小さいため、プーリ部に対してベルト推力が作用したとき、プーリ部がシャフトに対して傾いたり、シャフトとの接合部に亀裂などが発生しやすく、ベルト推力に対する剛性が低いという問題があった。
【０００６】

【発明が解決しようとする課題】
そこで、本願出願人は、図４，図５に示すように、鋼製シャフト２０にフランジ部２１を設け、このフランジ部２１と軽合金製のプーリ部３０の背面とを相対回転させながら摩擦圧接により接合することで、接合強度の高く、ベルト推力に対する剛性が高い無段変速機用プーリを提案した（特願２００１－２７１２９１号）。
図４，図５において、フランジ部２１の一側面に第１接合面２２が形成され、これと対向するプーリ部３０の背面に凹状の第２接合面３２が形成されている。なお、３１はベルト接触面である。この無段変速機用プーリの場合、プーリ部３０の内径部とシャフト２０との結合強度を高めるため、フランジ部２１の第１接合面２２に隣接するシャフト２０の外周部に、軟化した金属（軽合金）を充填するための周溝部２３を形成してある。
【０００７】
上記構造の場合、第１接合面２２と第２接合面３２とが平行な面で形成されているので、摩擦圧接時に第１接合面２２と第２接合面３２とが全面で摩擦する。ところが、摩擦面における外周側の周速度が大きく、外周側が内周側に比べて温度が高くなるので、外周側が先に軟化し、内周側が硬いままという状態になる。このような軟化温度の違いと、摩擦圧接時の遠心力とによって、軟化金属が外周側に集まりやすい。そのため、十分な軟化金属を周溝部２３に充填できず、シャフト２０とプーリ部３０との間で所望の結合強度が得られない場合があった。
【０００８】
そこで、本発明の目的は、シャフトに設けられる周溝部に十分な軟化金属を充填でき、フランジ部とプーリ部との結合強度が高い無段変速機用プーリの製造方法を提供することにある。
【０００９】
【課題を解決するための手段】
上記目的を達成するため、請求項１に係る発明は、鋼製のシャフトと軽合金製のプーリ部とからなる無段変速機用プーリの製造方法において、上記プーリ部と接合される第１接合面を有するフランジ部を一体に設けるとともに、上記フランジ部の第１接合面に隣接するシャフトの外周面に周溝部を形成したシャフトを準備する工程と、ベルト接触面と対向する背面に、内周側の軟化代を外周側の軟化代に比べて大きくした第２接合面を形成したプーリ部を準備する工程と、上記フランジ部の第１接合面とプーリ部の第２接合面とを相対回転させながら摩擦圧接により接合するとともに、軟化した金属の一部を上記周溝部に充填する工程と、を有する無段変速機用プーリの製造方法を提供する。
【００１０】
シャフトのフランジ部の第１接合面とプーリ部の背面の第２接合面とを接触させ、両接合面を相対回転させながら摩擦圧接させると、接合部にはフランジ部とプーリ部との相互拡散による冶金的な接合力が働き、剛体結合される。軸方向に対面するプーリ部の第２接合面とシャフトのフランジ部の第１接合面とが対面接合するので、プーリ部に推力が作用しても、プーリ部の倒れをシャフトのフランジ部で確実に支えることができる。そのため、プーリ部とシャフトとの接合幅を小さくでき、軸方向に薄型のプーリを構成できる。
また、フランジ部の第１接合面に隣接するシャフトの外周面に周溝部を形成し、この周溝部に摩擦圧接により軟化した軽合金の一部を充填している。特に、プーリ部の第２接合面は内周側の軟化代を外周側の軟化代に比べて大きくしてあるので、摩擦圧接時に内周側が先に摩擦され、軟化した金属がプーリ部の内径部へ多く移動する。そのため、周溝部およびシャフト外周とプーリ部内周との隙間を軟化金属で確実に埋めることができる。周溝部に充填され硬化した軽合金がアンカー効果を発揮するので、プーリ部の内径部とシャフト（フランジ部）との接合強度が向上する。
【００１１】
請求項２のように、フランジ部の第１接合面に、プーリ部のベルト接触面と同方向に傾斜したテーパ面を形成し、プーリ部の接合前の第２接合面に、第１接合面より頂角の大きなテーパ面を形成するのがよい。

この場合には、最初に摩擦圧接される面が内周側のみであり、その後、圧接が進行するにつれて摩擦面が外周側へ拡大する。このように、摩擦面が逐次拡大することで、軽合金製のプーリ部の接合面に存在する酸化皮膜は確実に破壊され、接合完了状態では酸化皮膜は確実に除去された状態で接合される。そのため、接合信頼性が高くなる。
なお、フランジ部の第１接合面の頂角をプーリ部のベルト接触面の頂角とほぼ同一角度にした場合には、接合完了状態においてフランジの第１接合面とベルト接触面とが平行になるので、フランジ部の外周端に対応するプーリ部の肉厚減少を小さくでき、ベルト推力に対する強度を向上させることが可能となる。換言すれば、プーリ部全体の肉厚を小さくしながら、所望の強度を維持することが可能となる。

【００１２】

【発明の実施の形態】
図１～図３は本発明にかかる無段変速機用プーリの一例を示し、図１は接合前、図２は接合途中、図３は接合後の状態を示す。
１は鋼製のシャフトであり、シャフト１には略円板状のフランジ部２が一体に形成されている。フランジ部２の一側面には、シャフト１の軸線に対して所定の頂角θ_1で傾斜したテーパ状の第１接合面２αが設けられている。この実施例では、第１接合面２αがフランジ２の内径部から外径部まで連続的に形成されている。第１接合面２αに隣接するシャフト１の外周面には、周溝部である肉ヌスミ部３が設けられている。

【００１３】

１０はアルミ合金よりなるプーリ部であり、プーリ部１０の一側面にはテーパ状のベルト接触面１１が設けられ、対向する背面にはフランジ部２よりやや大径な円形の凹部１２が設けられている。凹部１２の底面がフランジ部２の第１接合面２αと接合される第２接合面１２αであり、この第２接合面１２αはベルト接触面１１の頂角θ_2より大きな頂角θ_3を持つテーパ面となっている。なお、この実施例では、第２接合面１２αの内周部に、第２接合面１２αより小さい頂角θ_4を持つテーパ面１２ｂが形成されているが、このテーパ面１２ｂは摩擦接合時にフランジ部２の第１接合面２αと第２接合面１２αとがエッジ当たりするのを防止するためであり、省略してもよい。凹部１２の外周部には、接合後においてフランジ部２の外周面２ｂを間隔をあけて取り囲む環状溝１２ｃが形成されている。

【００１４】

上記のように第１接合面２α、第２接合面１２α、テーパ面１２ｂには、軸線と直角なフラット面が存在せず、テーパ面のみで構成されている。第１接合面２α、ベルト接触面１１、第２接合面１２αおよびテーパ面１２ｂのそれぞれの頂角θ_1～θ_4は次のように設定されている。
$\theta_1 = \theta_2 = \theta_4 < \theta_3$
ここでは、$\theta_1 = \theta_2 = \theta_4 = 77°$、$\theta_3 = 83°$に設定した。

【００１５】

次に、プーリ部１０をシャフト１のフランジ部２と接合する方法を説明する。
図２に示すように、プーリ部１０を図示しない固定装置によって固定するとともに、プーリ部１０の中心穴１３をシャフト１に挿入し、シャフト１を回転させながらフランジ部２をプーリ１０の背面（第２接合面１２α）方向に押し付けることで、フランジ部２の第１接合面２αとプーリ部１０の第２接合面１２αとを摩擦圧接させる。なお、プーリ部１０を固定し、シャフト１を回転させる方法に代えて、シャフト１を固定し、プーリ部１０を回転させて接合してもよい。このとき、第２接合面１２αの頂角θ_3が第１接合面２αの頂角θ_1より大きく設定されているので、第２接合面１２αの内周側（テーパ面１２ｂ）が先に摩擦され、軟化したアルミ合金がシャフト１の肉ヌスミ部３および中心穴１３とシャフト１との隙間に充填され、冷却後、硬化する。そのため、シャフト１外周とプーリ部１０内周との隙間を軟化金属で確実に埋めることができ、両者の結合強度を高くすることができる。摩擦圧接が進行すると、摩擦面が外周へ拡大し、軟化した金属は外径側へ流動して環状溝１２ｃに溜められる（図３参照）。そのため、外径側へ流れた軟化金属が

、プーリ部１０の背面側へはみ出ることがない。

【００１６】

上記のように第１接合面２αと第２接合面１２αとの間に、鋼とアルミの相互拡散による冶金的な接合力が働くと同時に、シャフト１に設けた肉ヌスミ部３にアルミ合金が充填されて機械的な結合力が働くので、シャフト１とプーリ部１０とは高強度に接合される。また、圧接後の冷却によりアルミ合金が硬化する時、鋼とアルミの熱収縮差によって肉ヌスミ部３に充填されたアルミに締付力が作用するので、一層強固な結合が行われる。

また、第２接合面１２αの頂角θ_3　が第１接合面２αの頂角θ_1　より大きく設定されているので、プーリ部１０の第２接合面２αの内周側の軟化代を外周側の軟化代に比べて大きくすることができる。そのため、多くの軟化金属（アルミ）が肉ヌスミ部３へと充填され、プーリ部１０とシャフト１とを強固に固定することができる。

さらに、摩擦圧接時に第２接合面１２αの内周側が先に摩擦され、摩擦圧接が進行するに従い逐次摩擦面が外周へ拡大するようにしたので、第２接合面１２αに存在する酸化皮膜は確実に破壊され、外周側へ排出される。そのため、接合状態では第１接合面２αとプーリ部１０との間には酸化皮膜が殆ど存在せず、接合信頼性が高くなる。

【００１７】

図３に示すように、シャフト１とプーリ部１０とを結合したプーリにＶベルトＢを巻き掛けて駆動すると、プーリ部１０の外径部が推力によって矢印方向Ｆ１へ押される。そのため、プーリ部１０にはモーメントＭが作用し、プーリ部１０の内径部が矢印Ｆ２のように反対方向へ変位しようとする。これに対し、鋼よりなるフランジ部２がプーリ部１０を背後から支えるので、プーリ部１０の傾きや　みを抑制できるとともに、肉ヌスミ部３に充填されたプーリ部１０のアルミ合金がアンカー効果を発揮し、プーリ部１０の内径部の浮き上がりや亀裂を防止できる。そのため、ベルト推力に対して剛性の高い無段変速機用プーリとなる。

また、推力Ｆ１によってフランジ部２のエッジとプーリ部１０のベルト接触面１１とを結ぶ最短経路（図３に破線Ｌで示す）に最大荷重が作用するが、上記構造のプーリ部１０の場合、接合状態においてプーリ部１０のベルト接触面１１とフランジ部２の第１接合面２αとがほぼ平行なテーパ面であるため、プーリ部１０の半径方向に厚みの変化がなく、プーリ部１０の破断を防止できる。換言すれば、プーリ部１０の肉厚を殊更大きくしなくても、プーリ部１０の破断を防止できる。

【００１８】

本発明のプーリは、乾式Ｖベルトを用いた無段変速機に好適である。すなわち、乾式Ｖベルトを用いた無段変速機の場合、プーリ推力は湿式のＶベルト式無段変速機に比べて約１／２～１／３程度と低いので、プーリを鋼製のシャフトとアルミ合金製のプーリ部との複合材で構成しても十分な耐久性が得られ、大型バイク、軽自動車、小型自動車用の乾式ベルトを用いた無段変速機などに実用範囲を広げることができる。

【００１９】

本発明は上記実施例に限定されるものではない。

上記実施例では、フランジ部の第１接合面をプーリ部のベルト接触面と同一角度のテーパ面とし、プーリ部の接合前の第２接合面を第１接合面より頂角の大きなテーパ面としたが、これに限るものではない。

例えば、フランジ部の第１接合面をベルト接触面と異なる頂角のテーパ面としてもよいし、軸線に対し直角なフラット面としてもよい。

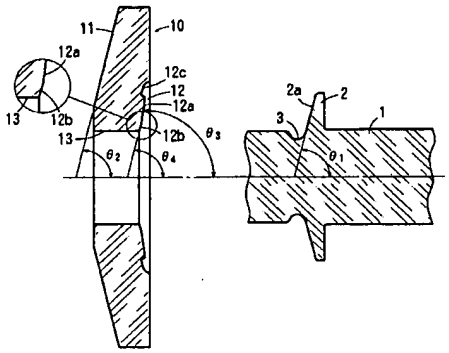
また、プーリ部の接合前の第２接合面をベルト接触面と逆方向に傾斜したテーパ面としてもよいし、テーパ面以外に、内径側と外径側との間に段差を持つ形状としてもよい。要するに、第２接合面は内周側の軟化代が外周側の軟化代に比べて大きいものであればよい。

本発明においてシャフトとは、中実のシャフトに限らず、中空のシャフト、スリーブ、ハブであってもよく、プーリの軸部を構成する部材であればよい。したがって、本発明のプーリは固定シーブに限らず、可動シーブにも適用できる。

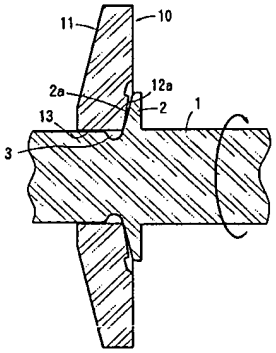
【００２０】

【発明の効果】
以上の説明で明らかなように、請求項１に記載の発明によれば、シャフトのフランジ部とプーリ部の背面とを摩擦圧接により接合したので、両金属の冶金的な接合力が働き、剛体結合される。しかも、軸方向に対面するプーリ部の背面とシャフトのフランジ部との対面接合であるから、プーリにかかる推力の方向が接合面に対してほぼ垂直方向となり、接合強度が高い。そのため、プーリ部とシャフトとの接合幅を小さくでき、軸方向に小型化できる。
摩擦圧接に必要な精度は、例えば圧入やねじ締結に比べて低い精度でよく、品質管理が容易である。さらに、摩擦圧接に要する時間は１分以内のように比較的短時間であるから、鋳込み，圧入，ねじ締結などの方法に比べて生産性に優れ、低コストで製造できる。
さらに、プーリ部の第２接合面の内周側の軟化代を外周側の軟化代に比べて大きくしてあるので、摩擦圧接時に内周側が先に摩擦され、軟化した金属がプーリ部の内径部へ多く移動する。そのため、シャフトの周溝部およびシャフト外周とプーリ部内周との隙間を軟化金属で確実に埋めることができ、プーリ部とシャフトとの接合強度が向上するという効果を有する。
【図面の簡単な説明】
【図１】本発明の一例である無段変速機用プーリの結合前の断面図である。
【図２】図１に示す無段変速機用プーリの結合途中の断面図である。
【図３】図１に示す無段変速機用プーリの結合後の断面図である。
【図４】本発明の前提となる無段変速機用プーリの結合前の断面図である。
【図５】図４に示すシャフトとプーリ部との結合後の断面図である。
【符号の説明】
１　シャフト
２　フランジ部
２α　第１接合面
３　肉ヌスミ部（周溝部）
１０　プーリ部
１１　ベルト接触面
１２α　第２接合面

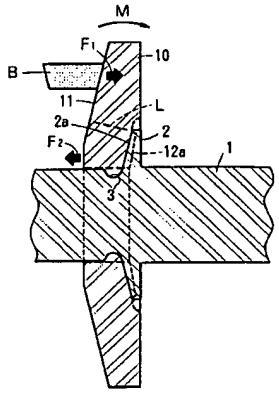
【図１】


11
10
12a
12c
12
12a
13
12b
13
12b
θ3
θ2
θ4
2a
2
3
1
θ1

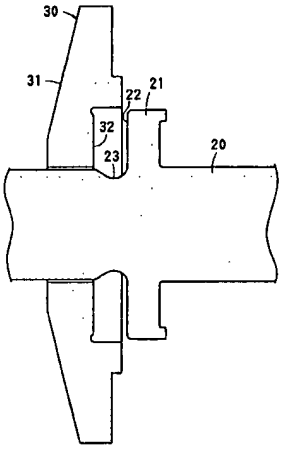
【図２】


11
10
2a
12a
2
1
13
3

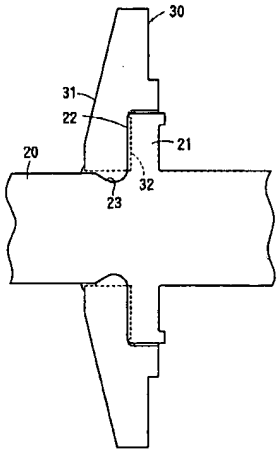
【図３】


M
F1
10
B
11
L
2a
2
F2
12a
1
3

【図４】


30
31
22
21
32
23
20

【図５】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32

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CLAIMS

[Claim(s)]
[Claim 1]
In the manufacture approach of the pulley for nonstep variable speed gears which consists of a steel shaft and the pulley section made from a light alloy,
The process which prepares the shaft in which the circumferential groove section was formed for the peripheral face of the shaft which adjoins the 1st plane of composition of the above-mentioned flange while preparing in one the flange which has the 1st plane of composition joined to the above-mentioned pulley section,
The process for which the pulley section in which the 2nd plane of composition which enlarged the softening cost by the side of inner circumference compared with the softening cost by the side of a periphery was formed at the belt contact surface and the tooth back which counters is prepared,
The manufacture approach of the pulley for nonstep variable speed gears of having the process which fills up the above-mentioned circumferential groove section with some softened metals while joining by friction welding, carrying out relative rotation of the 1st plane of composition of the above-mentioned flange, and the 2nd plane of composition of the pulley section.
[Claim 2]
The belt contact surface of the pulley section and the taper side which inclined in this direction are formed in the 1st plane of composition of the above-mentioned flange,
The manufacture approach of the pulley for nonstep variable speed gears according to claim 1 characterized by forming in the 2nd plane of composition before junction of the above-mentioned pulley section the taper side where a vertical angle is bigger than the 1st plane of composition of the above.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention]
This invention relates to the manufacture approach of the pulley for nonstep variable speed gears, especially the manufacture approach of the pulley of a composite construction which consists of a steel shaft and the pulley section made from a light alloy.
[0002]
[Description of the Prior Art]
[Patent reference 1] JP,63-104790,A
Although the various nonstep variable speed gears which perform automatic gear change using a V belt are put in practical use conventionally, constituting the pulley section from light alloys, such as an aluminum containing alloy, especially for lightweight-izing or the improvement of heat dissipation nature is performed. In that case, as for a power transfer shaft (shaft), it is desirable to use steel materials in order to secure the endurance over transfer torque. Therefore, only the pulley section rubbed against a belt is set as the object of light-alloy-izing.
[0003]
Although it is necessary to join a steel shaft and the pulley section made from an aluminum containing alloy to high intensity at this time, as a high intensity junction technique of the conventional steel and an aluminum containing alloy, "cast", "press fit", "conclusion which used with [of ****] the bundle", etc. can be considered. However, the quality control process cut any approach in many, and it had become cost quantity from the reasons of the required part of machining increasing.
[0004]
Then, the method of joining the pulley section made from aluminum and a steel shaft to the patent reference 1 by the friction joint like a publication is proposed. This approach makes the bore of the pulley section made from aluminum smaller than the outer diameter of a steel shaft, it fixes the pulley section, rotates a shaft, contacts a plane of composition, applies a pressure, suspends rotation of a shaft after insertion, and it is pressurized further and it joins it.
[0005]
Since the inner skin of the pulley section and the peripheral face of a shaft become with a plane of composition in the case of the above-mentioned junction approach, the thrust (axial load) concerning the pulley section acts in the shear direction to a plane of composition. Therefore, there is a fault that must take the large junction width of face of the pulley section and a shaft in order to raise bonding strength, and the thickness of the bore section of the pulley section becomes large, and weight becomes large. Moreover, since the plane-of-composition product of the pulley section and a shaft was small, when a belt thrust acted to the pulley section, the pulley section inclined to the shaft, or it was easy to generate a crack etc. in a joint with a shaft, and there was a problem that the rigidity over a belt thrust was low.
[0006]
[Problem(s) to be Solved by the Invention]

Then, the pulley for nonstep variable speed gears with bonding strength high [as shown in drawing 4 and drawing 5 , while an applicant for this patent forms a flange 21 in the steel shaft 20 and does relative rotation of the tooth back of this flange 21 and the pulley section 30 made from a light alloy, are joining by friction welding, and], and the high rigidity over a belt thrust was proposed (application for patent No. 271291 [2001 to]).
In drawing 4 and drawing 5 , the 1st plane of composition 22 is formed in one side face of a flange 21, and the 2nd concave plane of composition 32 is formed in the tooth back of this and the pulley section 30 which counters. In addition, 31 is the belt contact surface. In order to raise the bond strength of the bore section of the pulley section 30, and a shaft 20 in the case of this pulley for nonstep variable speed gears, the circumferential groove section 23 for filling up with the softened metal (light alloy) the periphery section of the shaft 20 which adjoins the 1st plane of composition 22 of a flange 21 is formed.
[0007]
Since the 1st plane of composition 22 and the 2nd plane of composition 32 are formed in respect of being parallel in the case of the above-mentioned structure, the 1st plane of composition 22 and the 2nd plane of composition 32 rub on the whole surface at the time of friction welding. However, the peripheral velocity by the side of the periphery in a friction surface is large, since temperature becomes [a periphery side] high compared with an inner circumference side, a periphery side softens previously and an inner circumference side will be in the condition of saying that it is still hard. A softening metal is an assembly and a cone to a periphery side by the difference in such softening temperature, and the centrifugal force at the time of friction welding. Therefore, the circumferential groove section 23 could not be filled up with enough softening metals, but there was a case where desired bond strength was not obtained between a shaft 20 and the pulley section 30.
[0008]
Then, the purpose of this invention can be filled up with enough softening metals for the circumferential groove section prepared in a shaft, and is to offer the manufacture approach of the pulley for nonstep variable speed gears with the high bond strength of a flange and the pulley section.
[0009]
[Means for Solving the Problem]
In order to attain the above-mentioned purpose, invention concerning claim 1 While preparing in one the flange which has the 1st plane of composition joined to the above-mentioned pulley section in the manufacture approach of the pulley for nonstep variable speed gears which consists of a steel shaft and the pulley section made from a light alloy The process which prepares the shaft in which the circumferential groove section was formed for the peripheral face of the shaft which adjoins the 1st plane of composition of the above-mentioned flange, The process for which the pulley section in which the 2nd plane of composition which enlarged the softening cost by the side of inner circumference compared with the softening cost by the side of a periphery was formed at the belt contact surface and the tooth back which counters is prepared, While joining by friction welding, carrying out relative rotation of the 1st plane of composition of the above-mentioned flange, and the 2nd plane of composition of the pulley section, the manufacture approach of the pulley for nonstep variable speed gears of having the process which fills up the above-mentioned circumferential groove section with some softened metals is offered.
[0010]
The 1st plane of composition of the flange of a shaft and the 2nd plane of composition of the tooth back of the pulley section are contacted, if friction welding is carried out, carrying out relative rotation of both the planes of composition, to a joint, the metallurgy junction force by the counter diffusion of a flange and the pulley section will work, and rigid-body association will be carried out at it. Since the 2nd plane of composition of the pulley section and the 1st plane of composition of the flange of a shaft which meet shaft orientations carry out confrontation junction, even if a thrust acts on the pulley section, **** of the pulley section is certainly supportable by the flange of a shaft. Therefore, junction width of face of the pulley section and a shaft can be made small, and a thin pulley can be constituted in shaft orientations.

Moreover, the circumferential groove section was formed in the peripheral face of the shaft which adjoins the 1st plane of composition of a flange, and it is filled up with some light alloys softened by friction welding in this circumferential groove section. Since the 2nd plane of composition of the pulley section has enlarged the softening cost by the side of inner circumference especially compared with the softening cost by the side of a periphery, an inner circumference side is previously rubbed at the time of friction welding, and many softened metals move to the bore section of the pulley section. Therefore, the clearance between the circumferential groove section and a shaft periphery, and pulley section inner circumference can be certainly filled with a softening metal. Since the light alloy which the circumferential groove section was filled up and hardened demonstrates an anchor effect, the bonding strength of the bore section of the pulley section and a shaft (flange) improves.

[0011]

It is good to form in the 1st plane of composition of a flange the belt contact surface of the pulley section, and the taper side which inclined in this direction, and to form in the 2nd plane of composition before junction of the pulley section the taper side where a vertical angle is bigger than the 1st plane of composition like claim 2.

In this case, the field by which friction welding is carried out first is only an inner circumference side, and a friction surface is expanded to a periphery side as a pressure welding advances after that. Thus, the oxide film which exists in the plane of composition of the pulley section made from a light alloy by a friction surface being expanded serially is destroyed certainly, and an oxide film is joined in the condition of having been removed certainly, in the state of the completion of junction. Therefore, junction dependability becomes high.

In addition, since the 1st plane of composition and the belt contact surface of a flange become parallel in the completion condition of junction when the vertical angle of the 1st plane of composition of a flange is mostly used as the vertical angle of the belt contact surface of the pulley section at the same include angle, wall thickness reduction of the pulley section corresponding to the periphery edge of a flange can be made small, and it becomes possible to raise the reinforcement to a belt thrust. If it puts in another way, it will become possible to maintain desired reinforcement, making thickness of the whole pulley section small.

[0012]

[Embodiment of the Invention]

Drawing 1 - drawing 3 show an example of the pulley for nonstep variable speed gears concerning this invention, and, as for drawing 1 , drawing 3 shows the condition after junction before junction in the middle of junction, as for drawing 2 .

1 is a steel shaft and the approximate circle tabular flange 2 is formed in the shaft 1 at one. It is [as opposed to / in one side face of a flange 2 / the axis of a shaft 1] the predetermined vertical angle theta 1. 1st plane-of-composition 2a of the shape of an inclined taper is prepared. In this example, 1st plane-of-composition 2a is continuously formed from the bore section of a flange 2 to the outer-diameter section. The meat NUSUMI section 3 which is the circumferential groove section is formed in the peripheral face of the shaft 1 which adjoins 1st plane-of-composition 2a.

[0013]

10 is the pulley section which consists of an aluminum containing alloy, the taper-like belt contact surface 11 is established in one side face of the pulley section 10, and the circular crevice [a little major diameter / flange / 2] 12 is established in the tooth back which counters. The base of a crevice 12 is 2nd plane-of-composition 12a joined to 1st plane-of-composition 2a of a flange 2, and this 2nd plane-of-composition 12a is the vertical angle theta 2 of the belt contact surface 11. Big vertical angle theta 3 It is the taper side which it has. In addition, vertical angle theta 4 smaller than 2nd plane-of-composition 12a in the inner circumference section of 2nd plane-of-composition 12a in this example Although taper side 12b which it has is formed, this taper side 12b is for preventing, and may omit that 1st plane-of-composition 2a and 2nd plane-of-composition 12a of a flange 2 carry out per edge at the time of a friction joint. Circular-sulcus 12c which opens spacing and encloses peripheral face 2b of a flange 2 after junction is formed in the periphery section of a crevice 12.

[0014]
As mentioned above, an axis and a right-angled flat side do not exist in 1st plane-of-composition 2a, 2nd plane-of-composition 12a, and taper side 12b, but only taper sides are consisted of. Each vertical-angle theta1 -theta4 of 1st plane-of-composition 2a, the belt contact surface 11, 2nd plane-of-composition 12a, and taper side 12b It is set up as follows.
theta1 =theta2 =theta4 <theta3
Here, it was set as theta1 =theta2 =theta4 =77 degree and theta3 =83 degree.
[0015]
Next, how to join the pulley section 10 to the flange 2 of a shaft 1 is explained.
As shown in drawing 2 , while fixing with the locking device which does not illustrate the pulley section 10, friction welding of 1st plane-of-composition 2a of a flange 2 and the 2nd plane-of-composition 12a of the pulley section 10 is carried out by forcing a flange 2 in the direction of a tooth back (2nd plane-of-composition 12a) of a pulley 10, inserting the main hole 13 of the pulley section 10 in a shaft 1, and rotating a shaft 1. In addition, the pulley section 10 is fixed, it may replace with the approach of rotating a shaft 1, a shaft 1 may be fixed, the pulley section 10 may be rotated, and you may join. At this time, it is the vertical angle theta 3 of 2nd plane-of-composition 12a. Vertical angle theta 1 of 1st plane-of-composition 2a Since it is set up greatly, the inner circumference side (taper side 12b) of 2nd plane-of-composition 12a is rubbed previously, the clearance between the meat NUSUMI section 3 of a shaft 1 and the main hole 13, and a shaft 1 is filled up with the softened aluminum containing alloy, and it hardens after cooling. Therefore, the clearance between shaft 1 periphery and pulley section 10 inner circumference can be certainly filled with a softening metal, and both bond strength can be made high. If friction welding advances, a friction surface is expanded to a periphery, and the softened metal will flow to an outer-diameter side, and will be accumulated in circular-sulcus 12c (refer to drawing 3).
Therefore, the softening metal which flowed to the outer-diameter side does not overflow into the tooth-back side of the pulley section 10.
[0016]
Since the meat NUSUMI section 3 prepared in the shaft 1 is filled up with an aluminum containing alloy and mechanical bonding strength works as mentioned above at the same time the metallurgy junction force by the counter diffusion of steel and aluminum works between 1st plane-of-composition 2a and 2nd plane-of-composition 12a, a shaft 1 and the pulley section 10 are joined by high intensity.
Moreover, since clamping force acts on the aluminum with which the meat NUSUMI section 3 was filled up by the heat shrink difference of steel and aluminum when an aluminum containing alloy hardens by cooling after a pressure welding, still firmer association is performed.
Moreover, vertical angle theta 3 of 2nd plane-of-composition 12a Vertical angle theta 1 of 1st plane-of-composition 2a Since it is set up greatly, the softening cost by the side of the inner circumference of 2nd plane-of-composition 2a of the pulley section 10 can be enlarged compared with the softening cost by the side of a periphery. Therefore, it fills up with many softening metals (aluminum) to the meat NUSUMI section 3, and they can fix the pulley section 10 and a shaft 1 firmly.
Furthermore, since it was made for a friction surface to be serially expanded to a periphery as the inner circumference side of 2nd plane-of-composition 12a was previously rubbed at the time of friction welding and friction welding advanced, it is destroyed certainly and the oxide film which exists in 2nd plane-of-composition 12a is discharged to a periphery side. Therefore, in the state of junction, an oxide film hardly exists between 1st plane-of-composition 2a and the pulley section 10, but junction dependability becomes high.
[0017]
If V belt B is rolled almost and driven to the pulley which combined a shaft 1 and the pulley section 10 as shown in drawing 3 , the outer-diameter section of the pulley section 10 will be pushed in the direction F1 of an arrow head with a thrust. Therefore, the moment M tends to act on the pulley section 10, and the bore section of the pulley section 10 tends to displace to an opposite direction like an arrow head F2. On the other hand, since the flange 2 which consists of steel supports the pulley section 10 from behind, while being able to control the inclination of the pulley section 10, and bending, the

aluminum containing alloy of the pulley section 10 with which the meat NUSUMI section 3 was filled up demonstrates an anchor effect, and can prevent the relief and crack of the bore section of the pulley section 10. Therefore, it becomes a rigid high pulley for nonstep variable speed gears to a belt thrust. Moreover, although maximum load acts on the shortest path (a broken line L shows to drawing 3) which connects the edge of a flange 2, and the belt contact surface 11 of the pulley section 10 with a thrust F1, since the belt contact surface 11 of the pulley section 10 and 1st plane of composition 2a of a flange 2 are almost parallel taper sides in a junction condition in the case of the pulley section 10 of the above-mentioned structure, there is no change of thickness in radial [of the pulley section 10], and fracture of the pulley section 10 can be prevent. If it puts in another way, even if it does not enlarge thickness of the pulley section 10 especially, fracture of the pulley section 10 can be prevented.

[0018]

The pulley of this invention is suitable for the nonstep variable speed gear which used the dry type V belt. That is, since a pulley thrust is as low as about about 1 / two to 1/3 compared with a wet V belt type nonstep variable speed gear in the case of the nonstep variable speed gear using a dry type V belt, even if it constitutes a pulley from composite of a steel shaft and the pulley section made from an aluminum containing alloy, sufficient endurance is acquired, and the practical use range can be extended to the nonstep variable speed gear using the dry type belt for a large-sized motorbike, a light car, and minicars etc.

[0019]

This invention is not limited to the above-mentioned example.

Although the 1st plane of composition of a flange was made into the taper side of the same include angle as the belt contact surface of the pulley section and the 2nd plane of composition before junction of the pulley section was made into the taper side where a vertical angle is bigger than the 1st plane of composition in the above-mentioned example, it does not restrict to this.

For example, it is good also as a taper side of a vertical angle which is different from the belt contact surface in the 1st plane of composition of a flange, and good also as a right-angled flat side to an axis. Moreover, it is good also as a taper side which inclined the 2nd plane of composition before junction of the pulley section to the belt contact surface and hard flow, and good also as a configuration with a level difference between a bore side and an outer-diameter side in addition to a taper side. In short, the 2nd plane of composition should have the just large softening cost by the side of inner circumference compared with the softening cost by the side of a periphery.

In this invention, shafts may be the shaft of not only the shaft of a solid but hollow, a sleeve, and a hub, and should just be members which constitute the shank of a pulley. Therefore, the pulley of this invention is applicable not only to a fixed sheave but a movable sheave.

[0020]

[Effect of the Invention]

By the above explanation, since the flange of a shaft and the tooth back of the pulley section were joined by friction welding according to invention according to claim 1 so that clearly, the metallurgy junction force of both metals works and rigid-body association is carried out. And since it is confrontation junction to the tooth back of the pulley section and the flange of a shaft which meet shaft orientations, the direction of the thrust concerning a pulley becomes almost perpendicular to a plane of composition, and bonding strength is high. Therefore, junction width of face of the pulley section and a shaft can be made small, and it can miniaturize in shaft orientations.

A precision required for friction welding is good in a low precision compared with press fit or **** conclusion, and easy to control quality the quality. Furthermore, like less than 1 minute, since the time amount which friction welding takes is a short time comparatively, it is cast, is excellent in productivity compared with approaches, such as press fit and **** conclusion, and can be manufactured by low cost. Furthermore, since the softening cost by the side of the inner circumference of the 2nd plane of composition of the pulley section is enlarged compared with the softening cost by the side of a periphery, an inner circumference side is previously rubbed at the time of friction welding, and many softened metals move to the bore section of the pulley section. Therefore, the circumferential groove

section of a shaft and the clearance between a shaft periphery and pulley section inner circumference can be certainly filled with a softening metal, and it has the effectiveness that the bonding strength of the pulley section and a shaft improves.

[Brief Description of the Drawings]

[Drawing 1] It is a sectional view before association of the pulley for nonstep variable speed gears which is an example of this invention.

[Drawing 2] It is a sectional view in the middle of joint [of the pulley for nonstep variable speed gears shown in drawing 1].

[Drawing 3] It is a sectional view after association of the pulley for nonstep variable speed gears shown in drawing 1 .

[Drawing 4] It is a sectional view before association of the pulley for nonstep variable speed gears which will be the requisite for this invention.

[Drawing 5] It is a sectional view after association with the shaft shown in drawing 4 , and the pulley section.

[Description of Notations]

1 Shaft
2 Flange
2a The 1st plane of composition
3 Meat NUSUMI Section (Circumferential Groove Section)
10 Pulley Section
11 Belt Contact Surface
12a The 2nd plane of composition

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TECHNICAL FIELD

[Field of the Invention]
This invention relates to the manufacture approach of the pulley for nonstep variable speed gears, especially the manufacture approach of the pulley of a composite construction which consists of a steel shaft and the pulley section made from a light alloy.
[0002]

[Translation done.]

* NOTICES *

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PRIOR ART

[Description of the Prior Art]
[Patent reference 1] JP,63-104790,A
Although the various nonstep variable speed gears which perform automatic gear change using a V belt are put in practical use conventionally, constituting the pulley section from light alloys, such as an aluminum containing alloy, especially for lightweight-izing or the improvement of heat dissipation nature is performed. In that case, as for a power transfer shaft (shaft), it is desirable to use steel materials in order to secure the endurance over transfer torque. Therefore, only the pulley section rubbed against a belt is set as the object of light-alloy-izing.
[0003]
Although it is necessary to join a steel shaft and the pulley section made from an aluminum containing alloy to high intensity at this time, as a high intensity junction technique of the conventional steel and an aluminum containing alloy, "cast", "press fit", "conclusion which used with [of ****] the bundle", etc. can be considered. However, the quality control process cut any approach in many, and it had become cost quantity from the reasons of the required part of machining increasing.
[0004]
Then, the method of joining the pulley section made from aluminum and a steel shaft to the patent reference 1 by the friction joint like a publication is proposed. This approach makes the bore of the pulley section made from aluminum smaller than the outer diameter of a steel shaft, it fixes the pulley section, rotates a shaft, contacts a plane of composition, applies a pressure, suspends rotation of a shaft after insertion, and it is pressurized further and it joins it.
[0005]
Since the inner skin of the pulley section and the peripheral face of a shaft become with a plane of composition in the case of the above-mentioned junction approach, the thrust (axial load) concerning the pulley section acts in the shear direction to a plane of composition. Therefore, there is a fault that must take the large junction width of face of the pulley section and a shaft in order to raise bonding strength, and the thickness of the bore section of the pulley section becomes large, and weight becomes large. Moreover, since the plane-of-composition product of the pulley section and a shaft was small, when a belt thrust acted to the pulley section, the pulley section inclined to the shaft, or it was easy to generate a crack etc. in a joint with a shaft, and there was a problem that the rigidity over a belt thrust was low.
[0006]

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EFFECT OF THE INVENTION

[Effect of the Invention]
By the above explanation, since the flange of a shaft and the tooth back of the pulley section were joined by friction welding according to invention according to claim 1 so that clearly, the metallurgy junction force of both metals works and rigid-body association is carried out. And since it is confrontation junction to the tooth back of the pulley section and the flange of a shaft which meet shaft orientations, the direction of the thrust concerning a pulley becomes almost perpendicular to a plane of composition, and bonding strength is high. Therefore, junction width of face of the pulley section and a shaft can be made small, and it can miniaturize in shaft orientations.
A precision required for friction welding is good in a low precision compared with press fit or **** conclusion, and easy to control quality the quality. Furthermore, like less than 1 minute, since the time amount which friction welding takes is a short time comparatively, it is cast, is excellent in productivity compared with approaches, such as press fit and **** conclusion, and can be manufactured by low cost. Furthermore, since the softening cost by the side of the inner circumference of the 2nd plane of composition of the pulley section is enlarged compared with the softening cost by the side of a periphery, an inner circumference side is previously rubbed at the time of friction welding, and many softened metals move to the bore section of the pulley section. Therefore, the circumferential groove section of a shaft and the clearance between a shaft periphery and pulley section inner circumference can be certainly filled with a softening metal, and it has the effectiveness that the bonding strength of the pulley section and a shaft improves.

[Translation done.]

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TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention]
Then, the pulley for nonstep variable speed gears with bonding strength high [as shown in drawing 4 and drawing 5 , while an applicant for this patent forms a flange 21 in the steel shaft 20 and does relative rotation of the tooth back of this flange 21 and the pulley section 30 made from a light alloy, are joining by friction welding, and], and the high rigidity over a belt thrust was proposed (application for patent No. 271291 [2001 to]).
In drawing 4 and drawing 5 , the 1st plane of composition 22 is formed in one side face of a flange 21, and the 2nd concave plane of composition 32 is formed in the tooth back of this and the pulley section 30 which counters. In addition, 31 is the belt contact surface. In order to raise the bond strength of the bore section of the pulley section 30, and a shaft 20 in the case of this pulley for nonstep variable speed gears, the circumferential groove section 23 for filling up with the softened metal (light alloy) the periphery section of the shaft 20 which adjoins the 1st plane of composition 22 of a flange 21 is formed.
[0007]
Since the 1st plane of composition 22 and the 2nd plane of composition 32 are formed in respect of being parallel in the case of the above-mentioned structure, the 1st plane of composition 22 and the 2nd plane of composition 32 rub on the whole surface at the time of friction welding. However, the peripheral velocity by the side of the periphery in a friction surface is large, since temperature becomes [a periphery side] high compared with an inner circumference side, a periphery side softens previously and an inner circumference side will be in the condition of saying that it is still hard. A softening metal is an assembly and a cone to a periphery side by the difference in such softening temperature, and the centrifugal force at the time of friction welding. Therefore, the circumferential groove section 23 could not be filled up with enough softening metals, but there was a case where desired bond strength was not obtained between a shaft 20 and the pulley section 30.
[0008]
Then, the purpose of this invention can be filled up with enough softening metals for the circumferential groove section prepared in a shaft, and is to offer the manufacture approach of the pulley for nonstep variable speed gears with the high bond strength of a flange and the pulley section.
[0009]

[Translation done.]

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MEANS

[Means for Solving the Problem]
In order to attain the above-mentioned purpose, invention concerning claim 1 While preparing in one the flange which has the 1st plane of composition joined to the above-mentioned pulley section in the manufacture approach of the pulley for nonstep variable speed gears which consists of a steel shaft and the pulley section made from a light alloy The process which prepares the shaft in which the circumferential groove section was formed for the peripheral face of the shaft which adjoins the 1st plane of composition of the above-mentioned flange, The process for which the pulley section in which the 2nd plane of composition which enlarged the softening cost by the side of inner circumference compared with the softening cost by the side of a periphery was formed at the belt contact surface and the tooth back which counters is prepared, While joining by friction welding, carrying out relative rotation of the 1st plane of composition of the above-mentioned flange, and the 2nd plane of composition of the pulley section, the manufacture approach of the pulley for nonstep variable speed gears of having the process which fills up the above-mentioned circumferential groove section with some softened metals is offered.
[0010]
The 1st plane of composition of the flange of a shaft and the 2nd plane of composition of the tooth back of the pulley section are contacted, if friction welding is carried out, carrying out relative rotation of both the planes of composition, to a joint, the metallurgy junction force by the counter diffusion of a flange and the pulley section will work, and rigid-body association will be carried out at it. Since the 2nd plane of composition of the pulley section and the 1st plane of composition of the flange of a shaft which meet shaft orientations carry out confrontation junction, even if a thrust acts on the pulley section, **** of the pulley section is certainly supportable by the flange of a shaft. Therefore, junction width of face of the pulley section and a shaft can be made small, and a thin pulley can be constituted in shaft orientations.
Moreover, the circumferential groove section was formed in the peripheral face of the shaft which adjoins the 1st plane of composition of a flange, and it is filled up with some light alloys softened by friction welding in this circumferential groove section. Since the 2nd plane of composition of the pulley section has enlarged the softening cost by the side of inner circumference especially compared with the softening cost by the side of a periphery, an inner circumference side is previously rubbed at the time of friction welding, and many softened metals move to the bore section of the pulley section. Therefore, the clearance between the circumferential groove section and a shaft periphery, and pulley section inner circumference can be certainly filled with a softening metal. Since the light alloy which the circumferential groove section was filled up and hardened demonstrates an anchor effect, the bonding strength of the bore section of the pulley section and a shaft (flange) improves.
[0011]
It is good to form in the 1st plane of composition of a flange the belt contact surface of the pulley section, and the taper side which inclined in this direction, and to form in the 2nd plane of composition before junction of the pulley section the taper side where a vertical angle is bigger than the 1st plane of

composition like claim 2.
In this case, the field by which friction welding is carried out first is only an inner circumference side, and a friction surface is expanded to a periphery side as a pressure welding advances after that. Thus, the oxide film which exists in the plane of composition of the pulley section made from a light alloy by a friction surface being expanded serially is destroyed certainly, and an oxide film is joined in the condition of having been removed certainly, in the state of the completion of junction. Therefore, junction dependability becomes high.
In addition, since the 1st plane of composition and the belt contact surface of a flange become parallel in the completion condition of junction when the vertical angle of the 1st plane of composition of a flange is mostly used as the vertical angle of the belt contact surface of the pulley section at the same include angle, wall thickness reduction of the pulley section corresponding to the periphery edge of a flange can be made small, and it becomes possible to raise the reinforcement to a belt thrust. If it puts in another way, it will become possible to maintain desired reinforcement, making thickness of the whole pulley section small.
[0012]
[Embodiment of the Invention]
Drawing 1 - drawing 3 show an example of the pulley for nonstep variable speed gears concerning this invention, and, as for drawing 1 , drawing 3 shows the condition after junction before junction in the middle of junction, as for drawing 2 .
1 is a steel shaft and the approximate circle tabular flange 2 is formed in the shaft 1 at one. It is [as opposed to / in one side face of a flange 2 / the axis of a shaft 1] the predetermined vertical angle theta 1. 1st plane-of-composition 2a of the shape of an inclined taper is prepared. In this example, 1st plane-of-composition 2a is continuously formed from the bore section of a flange 2 to the outer-diameter section. The meat NUSUMI section 3 which is the circumferential groove section is formed in the peripheral face of the shaft 1 which adjoins 1st plane-of-composition 2a.
[0013]
10 is the pulley section which consists of an aluminum containing alloy, the taper-like belt contact surface 11 is established in one side face of the pulley section 10, and the circular crevice [a little major diameter / flange / 2] 12 is established in the tooth back which counters. The base of a crevice 12 is 2nd plane-of-composition 12a joined to 1st plane-of-composition 2a of a flange 2, and this 2nd plane-of-composition 12a is the vertical angle theta 2 of the belt contact surface 11. Big vertical angle theta 3 It is the taper side which it has. In addition, vertical angle theta 4 smaller than 2nd plane-of-composition 12a in the inner circumference section of 2nd plane-of-composition 12a in this example Although taper side 12b which it has is formed, this taper side 12b is for preventing, and may omit that 1st plane-of-composition 2a and 2nd plane-of-composition 12a of a flange 2 carry out per edge at the time of a friction joint. Circular-sulcus 12c which opens spacing and encloses peripheral face 2b of a flange 2 after junction is formed in the periphery section of a crevice 12.
[0014]
As mentioned above, an axis and a right-angled flat side do not exist in 1st plane-of-composition 2a, 2nd plane-of-composition 12a, and taper side 12b, but only taper sides are consisted of. Each vertical-angle theta1 -theta4 of 1st plane-of-composition 2a, the belt contact surface 11, 2nd plane-of-composition 12a, and taper side 12b It is set up as follows.
theta1 =theta2 =theta4 <theta3
Here, it was set as theta1 =theta2 =theta4 =77 degree and theta3 =83 degree.
[0015]
Next, how to join the pulley section 10 to the flange 2 of a shaft 1 is explained.
As shown in drawing 2 , while fixing with the locking device which does not illustrate the pulley section 10, friction welding of 1st plane-of-composition 2a of a flange 2 and the 2nd plane-of-composition 12a of the pulley section 10 is carried out by forcing a flange 2 in the direction of a tooth back (2nd plane-of-composition 12a) of a pulley 10, inserting the main hole 13 of the pulley section 10 in a shaft 1, and rotating a shaft 1. In addition, the pulley section 10 is fixed, it may replace with the approach of rotating

a shaft 1, a shaft 1 may be fixed, the pulley section 10 may be rotated, and you may join. At this time, it is the vertical angle theta 3 of 2nd plane-of-composition 12a. Vertical angle theta 1 of 1st plane-of-composition 2a Since it is set up greatly, the inner circumference side (taper side 12b) of 2nd plane-of-composition 12a is rubbed previously, the clearance between the meat NUSUMI section 3 of a shaft 1 and the main hole 13, and a shaft 1 is filled up with the softened aluminum containing alloy, and it hardens after cooling. Therefore, the clearance between shaft 1 periphery and pulley section 10 inner circumference can be certainly filled with a softening metal, and both bond strength can be made high. If friction welding advances, a friction surface is expanded to a periphery, and the softened metal will flow to an outer-diameter side, and will be accumulated in circular-sulcus 12c (refer to drawing 3). Therefore, the softening metal which flowed to the outer-diameter side does not overflow into the tooth-back side of the pulley section 10.

[0016]

Since the meat NUSUMI section 3 prepared in the shaft 1 is filled up with an aluminum containing alloy and mechanical bonding strength works as mentioned above at the same time the metallurgy junction force by the counter diffusion of steel and aluminum works between 1st plane-of-composition 2a and 2nd plane-of-composition 12a, a shaft 1 and the pulley section 10 are joined by high intensity. Moreover, since clamping force acts on the aluminum with which the meat NUSUMI section 3 was filled up by the heat shrink difference of steel and aluminum when an aluminum containing alloy hardens by cooling after a pressure welding, still firmer association is performed.

Moreover, vertical angle theta 3 of 2nd plane-of-composition 12a Vertical angle theta 1 of 1st plane-of-composition 2a Since it is set up greatly, the softening cost by the side of the inner circumference of 2nd plane-of-composition 2a of the pulley section 10 can be enlarged compared with the softening cost by the side of a periphery. Therefore, it fills up with many softening metals (aluminum) to the meat NUSUMI section 3, and they can fix the pulley section 10 and a shaft 1 firmly.

Furthermore, since it was made for a friction surface to be serially expanded to a periphery as the inner circumference side of 2nd plane-of-composition 12a was previously rubbed at the time of friction welding and friction welding advanced, it is destroyed certainly and the oxide film which exists in 2nd plane-of-composition 12a is discharged to a periphery side. Therefore, in the state of junction, an oxide film hardly exists between 1st plane-of-composition 2a and the pulley section 10, but junction dependability becomes high.

[0017]

If V belt B is rolled almost and driven to the pulley which combined a shaft 1 and the pulley section 10 as shown in drawing 3 , the outer-diameter section of the pulley section 10 will be pushed in the direction F1 of an arrow head with a thrust. Therefore, the moment M tends to act on the pulley section 10, and the bore section of the pulley section 10 tends to displace to an opposite direction like an arrow head F2. On the other hand, since the flange 2 which consists of steel supports the pulley section 10 from behind, while being able to control the inclination of the pulley section 10, and bending, the aluminum containing alloy of the pulley section 10 with which the meat NUSUMI section 3 was filled up demonstrates an anchor effect, and can prevent the relief and crack of the bore section of the pulley section 10. Therefore, it becomes a rigid high pulley for nonstep variable speed gears to a belt thrust. Moreover, although maximum load acts on the shortest path (a broken line L shows to drawing 3) which connects the edge of a flange 2, and the belt contact surface 11 of the pulley section 10 with a thrust F1, since the belt contact surface 11 of the pulley section 10 and 1st plane of composition 2a of a flange 2 are almost parallel taper sides in a junction condition in the case of the pulley section 10 of the above-mentioned structure, there is no change of thickness in radial [of the pulley section 10], and fracture of the pulley section 10 can be prevent. If it puts in another way, even if it does not enlarge thickness of the pulley section 10 especially, fracture of the pulley section 10 can be prevented.

[0018]

The pulley of this invention is suitable for the nonstep variable speed gear which used the dry type V belt. That is, since a pulley thrust is as low as about about 1 / two to 1/3 compared with a wet V belt type nonstep variable speed gear in the case of the nonstep variable speed gear using a dry type V belt, even

if it constitutes a pulley from composite of a steel shaft and the pulley section made from an aluminum containing alloy, sufficient endurance is acquired, and the practical use range can be extended to the nonstep variable speed gear using the dry type belt for a large-sized motorbike, a light car, and minicars etc.

[0019]

This invention is not limited to the above-mentioned example.

Although the 1st plane of composition of a flange was made into the taper side of the same include angle as the belt contact surface of the pulley section and the 2nd plane of composition before junction of the pulley section was made into the taper side where a vertical angle is bigger than the 1st plane of composition in the above-mentioned example, it does not restrict to this.

For example, it is good also as a taper side of a vertical angle which is different from the belt contact surface in the 1st plane of composition of a flange, and good also as a right-angled flat side to an axis.

Moreover, it is good also as a taper side which inclined the 2nd plane of composition before junction of the pulley section to the belt contact surface and hard flow, and good also as a configuration with a level difference between a bore side and an outer-diameter side in addition to a taper side. In short, the 2nd plane of composition should have the just large softening cost by the side of inner circumference compared with the softening cost by the side of a periphery.

In this invention, shafts may be the shaft of not only the shaft of a solid but hollow, a sleeve, and a hub, and should just be members which constitute the shank of a pulley. Therefore, the pulley of this invention is applicable not only to a fixed sheave but a movable sheave.

[0020]

[Translation done.]

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is a sectional view before association of the pulley for nonstep variable speed gears which is an example of this invention.
[Drawing 2] It is a sectional view in the middle of joint [of the pulley for nonstep variable speed gears shown in drawing 1].
[Drawing 3] It is a sectional view after association of the pulley for nonstep variable speed gears shown in drawing 1 .
[Drawing 4] It is a sectional view before association of the pulley for nonstep variable speed gears which will be the requisite for this invention.
[Drawing 5] It is a sectional view after association with the shaft shown in drawing 4 , and the pulley section.
[Description of Notations]
1 Shaft
2 Flange
2a The 1st plane of composition
3 Meat NUSUMI Section (Circumferential Groove Section)
10 Pulley Section
11 Belt Contact Surface
12a The 2nd plane of composition

[Translation done.]